ISLE OF MAN GOVERNMENT

CASUALTY INVESTIGATION REPORT CA77

FAR SERVICE

MACHINERY SPACE FIRE - SHORE FATALITY

7th JULY 2002

1. Contents of Report

2. Summary

At about 0828 hours local time on the 7th July 2002, the Isle of Man registered platform supply vessel "Far Service" suffered a major flash fire in the engine room whilst berthed at Peterhead, Scotland.

At the time of and leading up to the incident the vessel's engines were run up in preparation for shifting to another berth whilst shore contractors, using their own equipment, were involved in the removing of base oil residue from No 4 starboard base oil tank, to a road tanker on the quay. The base oil tank is a side / DB tank located on the starboard side of the engine room and access to this tank is by a vertical manhole at the engine room starboard side upper level abreast of the starboard main engine.

In the engine room area at the time of the incident were the vessel's engine room staff and contractor's tank cleaning personnel tending the base oil hoses.

Immediately before the outbreak of fire, a shore contractor at the upper level starboard side, forward of the starboard main engine, was attempting to reconnect two ends of the suction hose. Large quantities of liquid, later ascertained to be base oil, were spilling from the forward section of the hose leading to the road tanker. The liquid ran over the walkway for'd of and adjacent to the main engine. Almost instantaneously a blanket of flame occurred in the area over the main engine and adjacent outboard walkway.

The fire, which rapidly engulfed the engine room, was detected on the bridge and the main engines were shut down. The vessel's staff evacuated the engine room to the deck where other crew were mustered and all were accounted for, although it was ascertained that one of the shore contractor's staff was missing.

The ship's staff prepared fire fighting equipment and closed the engine room down. They then attempted to enter the engine room to search for the missing person but were unable, due to the severity of the fire, although they started boundary cooling around the fire area.

The fire brigade were quickly on the scene at about 0835 hours. Due to the severity of the fire they made two unsuccessful attempts to enter the engine room to search for the missing person. However on a third attempt, when the fire had somewhat subsided, they managed to enter the engine room and located the missing person at the bottom of the upper stairwell of the main engine room access to the aft deck and pronounced the person dead.

Following the discovery of the missing person, at about 1000 hours, the vessel's CO2 fixed fire fighting system was activated. The engine room was flooded with CO2 gas to finally extinguish the fire which was generally completed by about 1030 hours. The engine room was then closed down for about 24 hours prior to ventilation and examination.

3. Narrative

3.1 The "Far Service" is a 3052gt platform supply vessel built in 1994, fitted with cargo tanks for the transportation of brine, mud and base oil, operating in the North Sea from Aberdeen, Scotland and manned with British and Portuguese officers and Portuguese ratings.

Events leading up to the incident

3.2 On the 6th July 2002, the vessel departed from Rig Sedco 711 at 2042 hours and proceeded to Peterhead under charterer's instructions for the purpose of their tank cleaning contractors cleaning mud and base oil tanks on arrival, and then working deck cargo.

3.3 As is a long established practice in the North Sea offshore industry, it was arranged for the cargo tank cleaning operation to be carried out in its entirety by shore contractors. The contractors are totally equipped with their own equipment including pumping / suction equipment, lighting and a road tanker to receive slops, and the ship's staff only isolate the tanks prior to the cleaning operation starting. A common practice is for the road tanker pressures to be lowered to vacuum levels and the fluid be sucked from the vessel rather than be pumped out to achieve better results.

3.4 The vessel arrived off Peterhead at 0500 hours on the 7th July 2002 and berthed starboard side to at 0524 hours at berth 15 North Base Breakwater, in preparation for taking fresh water, tank cleaning and loading two frames on deck. At about 0530 hours the Chief Engineer being the duty engineer started the auxiliaries and then shut down the main engines.

3.5 Shortly after berthing, the crew removed tank manhole covers located on the aft weather deck for the four (4) mud tanks being Nos 1 and 2 tanks, port and starboard. They also removed the tank manhole cover from the one (1) base oil tank (No 4 starboard) located in the forward engine room on the starboard side outboard of and close to the starboard main engine at the upper level. Access to this area can be gained from a direct stairwell from the aft upper open deck at the forward end of this level and also from the engine room control room at the same level, which in turn has a direct access from the reception area and open deck.

(See Appendix 1)

3.6 At about 0530 hours the charterer's tank inspector boarded "Far Service" to inspect the mud and base oil tanks by looking through the manholes prior to the commencement of the cleaning operation. He decided that the mud tanks should be washed to mud standard, whilst the base oil tank only needed the remains of previous base oil cargoes pumping out, estimated to be about 25 barrels.

3.7 Shortly afterwards, and in accordance with the practice as detailed in 3.3 above, the tank cleaning contractors (contractors) comprising of a group of six (6) persons employed by the vessel's charterers, arrived at the vessel.

3.8 They set up their equipment comprising of a suction hose running from the tanks to a road tanker unit on the quay. The hose was connected to the outlet valve of the road tanker to improve the suction, with the assistance of a vacuum booster (Cuzco Turbo Vac Unit) connected to the filling connection of the tanker. A permit to work was raised by the ship's staff to isolate any tank operations whilst tank cleaning was taking place. Tank entry requirements, to include checking the tank atmosphere and checking cleaning equipment was carried out by the contractors who endorsed the same ship's permit. The contractors also completed a tank entry check sheet and pre inspection checklist (undated) recording details of plant and equipment being used and subsequently recorded the gas and oxygen levels at hourly intervals and a timesheet.
(See Appendices 2 and 3)

3.9 The contractors initially cleaned the four mud tanks, which was completed by about 0745 hours, and the manhole covers were replaced.

3.10 The contractors then proceeded to the base oil tank to remove the remains of previous base oil cargoes. They ran a 4" rigid ribbed plastic coated suction hose, from the base oil tank, rigged in 5 lengths each of 10 metres length and connected by male/female ends pulled and held together with two levered clips. The hose led from the tank through the tank manhole into the starboard side of the engine room at upper level on the outer side of the starboard engine. There was a hose connection about 3 metres for'd of the tank manhole. The hose then led for'd up the starboard stairwell, where there were further hose connections, to the engine room entrance at the forward end of the aft weather deck, and then outside and upwards to a road tanker connected to a vacuum unit on the breakwater. The vacuum unit provided a vacuum in the road tanker to remove the base oil, the suction valve at the road tanker not being of the non return type.

3.11 At 0745 hours the Master received an instruction from the charterers that the vessel should be ready to shift berth to the South Base area at 0830 hours. At 0750 hours he requested the Chief Engineer to prepare the engines.

3.12 The removal of base oil started at about 0755 hours and the hose was tended by contractors in the engine room, inside the tank, on deck and at the road tanker.

3.13 The Chief Engineer proceeded to the engine room at 0750 hours, started up the second generator, started the standby pumps and prepared the main engines and thrusters at 0758 hours. The main engines were run up at the correct running temperature and engine control was transferred to the bridge by 0820 hours and the bridge was advised accordingly.

3.14 At about 0800 hours the Master advised the Chief Officer of the intention to shift berth at 0830 hours, and he in turn advised the contractor's foreman of this.

3.15 The 2nd Engineer came on duty at 0800 hours and proceeded to the engine room control room, where he initially discussed the day's work with the Chief Engineer, and then remained in the control room. The Chief Engineer then left the control room to collect machinery running hours for inputting into the planned maintenance system.

3.16 It is reported that at 0815 hours, the charterer's cargo loading foreman arrived at the quay and instructed the contractors to move the vacuum booster in order to position a crane and at 0820 hours, one of the contractor's staff shut off the valves on the road tanker as a safety precaution prior to moving the vacuum booster unit.

3.17 It is also reported that at about 0815 hours the contractor's staff in the engine room advised their colleagues on deck that the base oil tank was empty and that the operation could be suspended and hoses removed from the tank.

3.18 At about 0820 hours the Chief Engineer returned to the control room and the 2nd Engineer then entered the engine room via the starboard control room door, to carry out routine check rounds. He noted two contractor's staff close to No 4 starboard base oil tank manhole. Very soon afterwards the 2nd Engineer returned to the control room to collect some earplugs for the contractors and then returned to the engine room.

The incident

3.19 It is reported that at about 0821 hours, another of the contractors received an instruction from their charge hand to stop the operation, and being unaware of the circumstances of the vacuum booster unit, moved the valves on the road tanker into what he considered to be the closed position, but in fact re-opened them. It is presumed that at the same time, the contractor's staff in the engine room noted that the suction had stopped and started to disconnect the hose connection at the upper engine room plate level prior to pulling the hose from the tank.

3.20 The 2nd Engineer carried out his engine room rounds checking both generators, air compressors, fuel pump cleaning tanks, the starboard engine, fuel filters, heaters and purifiers. He finally ended up at the centre line of the engine room at tank top level just forward of the fore ends of the main engines.

3.21 Whilst carrying out his rounds, the 2nd Engineer noticed large quantities of clear liquid spilling over the edge of the upper engine room starboard walkway, between the starboard main engine turbo charger and the walkway and onto the main engine and other machinery.

3.22 The 2nd Engineer then looked up and noticed one of the contractors standing on the starboard walkway in the area of the corner of the guardrail and facing aft, just for'd of the starboard main engine, holding the clamp end of the hose, which led up to the deck. This person was struggling with the hose which seemed to have parted at the coupling, adjacent to the foreside of the starboard main engine. Large quantities of liquid were spilling out of the hose. He appeared to be attempting to reconnect the hose sections but was prevented by the volume of liquid coming out of the hose.

3.23 Suddenly the 2nd Engineer noticed a blanket of flame and smoke over the starboard main engine and the area became immediately obscured by smoke and flame. He then ran up the stairs to the port side door of the engine control room and advised the Chief Engineer of the fire.

3.24 At about 0828 hours the fire detection alarm sounded and at the same time the 2nd Engineer advised the bridge of the fire. The Master and Chief Officer who were on the bridge detected the fire on both the fire detection system panel for fire zone 8, and the CCTV monitor which showed flames and smoke at the same time, and they initiated the fire alarm.

3.25 The Chief Engineer attempted to open the starboard side engine control room door to assess the fire and how to deal with it, but was prevented from doing so by the severity of the fire on that side of the engine room and therefore closed the door. He then shut down both main engines and noted the starboard engine control room window cracking with the heat and orange flames and decided that the engine control room area should be evacuated. The Chief and 2nd Engineers and also the motorman who was working in the workshop adjacent to the engine room control room, all immediately evacuated the engine room area and proceeded to the aft weather deck.

Events following the incident

3.26 The Chief Officer immediately proceeded to the aft weather deck and mustered the ship's company and verified that they were all present, but on checking with the contractors, was advised that one of their staff was missing in the engine room between the aft engine room door to the deck and No 4 starboard tank. This was reported to the Master at 0832 hours.

3.27 Under the direction of the Chief Officer, the fire parties immediately commenced preparing fire hoses and fireman's outfits, whilst the ship's engineers closed down the engine room by closing funnel and fire flaps, quick closing valves and the emergency generator automatically started. Boundary cooling around the external sections of the fire areas commenced.

3.28 At about 0832 hours the Master made contact with Peterhead Harbour Tower Control advising of the fire and requested immediate assistance from the fire service and also the ambulance service in view of the missing person. The fire and ambulance services were on the scene by 0835 and 0837 hours respectively. The Master remained on the bridge to co-ordinate the emergency situation. He also shut down the engine room pumps, ventilation fans and watertight doors (at the fore side of the engine room control room and aft end of the engine room) using the remote stops/controls and also started the emergency fire pump.

3.29 The forward area of the aft weather deck over the engine room and the starboard side area of the engine casing and funnel were noted as being extremely hot.

3.30 Smoke and flames were noted emanating from the engine room door at the aft end of the accommodation block at weather deck level. The door was unable to be closed due to the contractor's hose and power cable wiring leading through the door into the engine room. However the Chief Officer and contractor's staff managed to creep below the flames to the lower part of the door where the visibility into the engine room was obscured by the fire and they severed the wire and broke the hose connection. About 2 gallons of liquid spilled out of the hose onto the Chief Officer's legs and the end of the hose and power cable were dropped into the engine room. The deck section of the hose was now clear of the stairwell and the door was then closed to prevent any further ingress of oxygen.

3.31 The ship's staff wearing fireman's outfits attempted to enter the engine room via the engine room door at the aft end of the accommodation block at weather deck level, to locate and rescue the missing person. They were unable to do so on account of the severity of the fire in the form of a fireball projecting outwards and upwards with billowing black smoke. The fire parties also checked the accommodation and noted only smoke.

3.32 When the fire brigade arrived at the scene they took charge of the fire fighting operations and were familiarised with the ship's fire plan and engine room layout by the ship's staff.

3.33 The fire brigade personnel, wearing fireman's outfits, made two unsuccessful attempts to enter the engine room, initially via the starboard control room door which would not open and secondly via the aft control room door and workshop but were prevented due to the intensity of the heat.

3.34 At about 0940 hours, when the fire had somewhat reduced in intensity, the fire brigade managed to enter the engine room and reported locating the missing person on the stairwell to the aft engine room entrance and pronounced him dead.

3.35 At 1000 hours and following the discovery of the body of the missing person, ship's staff actuated the CO2 fixed fire fighting system and gas was released into the engine room which controlled and largely extinguished the fire. Boundary cooling continued.

3.36 At about 1030 hours, fire brigade personnel accompanied by the 2nd Engineer re entered the engine room to check for hot spots using heat sensors. One hot spot was found in the vicinity of the turbo charger which they accordingly dealt with using portable fire equipment.

3.37 At 1100 hours the Fire Brigade considered that the fire was under control and boundary cooling was discontinued.

3.38 The engine room was again re-entered by the fire brigade personnel accompanied by the 2nd Engineer at about 1130 hours for the purpose of closing all accessible sea suction valves. The engine room was then shut down for about 24 hours prior to any further entry.

3.39 Deck cargo was discharged between 1515 and 1630 hours.

3.40 At 1700 hours the fire brigade carried out their final inspection for the day and the ship's staff were instructed to contact the police at the gangway if any further emergency developed overnight. The ship's staff later disembarked from the vessel to be accommodated ashore with the exception of a watch officer and rating who remained on board carrying out hourly rounds. Power was supplied via the emergency generator.

3.41 The body of the deceased person was removed from the vessel on the 8th July. On the 9th July, registered medical practitioners from the Forensic Medical Unit of Aberdeen University, carried out a post mortem on the body at Aberdeen Mortuary.

3.42 Following the incident, on the 8th and 9th July the investigating officer inspected the vessel in way of the fire damage, which was mainly confined to the engine room area, and noted the following:-

(i) On the starboard side of the engine room severe fire damage to machinery and electrical wiring and fittings in the area of the starboard main engine and exhaust generally at cylinder head level, the most severe damage being forward of the main engine, the main area of fire damage being concentrated between the main engine turbocharger and ladder to the control room, where base oil was noted spilling out from the hose. Adjacent auxiliary machinery at 2nd deck and tank top levels was also fire damaged

(ii) In above area, severe fire damage to paintwork on the steel structure of the wing base oil and heavy fuel oil tanks and also to associated electrical wiring and fittings

(iii) At the starboard for'd side of engine room at 2nd deck level in way of opening to stairwell leading up to main deck, severe fire damage to steelwork, paintwork and electrical wiring and fittings

(iv) Severe fire damage to steel structure, paintwork, electrical wiring and fittings within stairwell leading from engine room 2nd deck level at starboard side to aft weather deck

(v) Fire damage to a limited area of auxiliary machinery in way of air receiver bottles, at the port side of the engine room at tank top level

(vi) Fire and smoke damage under the tank top floor plates running across the engine room from the fire damage on the starboard side (see (i) above), to fire damage on the port side, (see (v) above)

(vii) Smoke damage in most areas of the engine room, although the engine room control room and engine room workshop were undamaged, with the exception of the control room starboard window which was cracked due to excessive heat

(viii) The remains of a fire damaged hose (approx. 4" diameter) and couplings in the engine room starboard side at 2nd deck level leading from the base oil tank manhole running for'd to the stairwell and upwards towards the aft weather deck

(ix) A portable electric light close to the base oil tank manhole

(x) Distorted steelwork on starboard side main engine casing and funnel at all levels

(See photographs in Appendix 4)

3.43 Sources of evidence were:-

(i) Reports from vessel's operator
(ii) Declarations and statements of facts provided by the ship's staff
(iii) Official report of incident from Master and log book extracts
(iv) Fire brigade report
(v) Inspection report on the road tanker and vacuum unit
(vi) Various photographs taken by the investigating officer and also provided by the operator's of the vessel
(vii) Copy of autopsy report
(viii) Copy of a preliminary report into the cause of the fire compiled by the owner's fire consultants including various photographs
(ix) Copies of technical data regarding the subject cargo (safety data sheet) (See Appendix 5)
(x) Vessel's files to include plans and transcript of register

(xi) Copies of an extract from vessel's Safety Management System, vessel's permit to work for the subject operation and the tank cleaning contractor's tank entry check sheet and pre-inspection checklist
(xii) Copies of a Safety Alert 21/02 and a Safety Bulletin issued by the tank cleaning contractors and vessel's managers respectively following the incident
(xiii) Copy of cargo tank surveyor's certificate
(xiv) Main engine temperature report from sister vessel
(xv) Examination of physical evidence on the vessel following the incident
(xvi) All times recorded are local time in the area of the incident, being GMT plus 1 hour

4. Analysis of Sources of Evidence

4.1 It should be noted that the interviewing officer only interviewed the ship's staff, but was not permitted to interview any of the tank cleaning contractors or inspect the road tanker. However second hand evidence regarding the base oil tank cleaning operation was obtained from the vessel's operators report, fire consultants report and consultants inspection report of road tanker and vacuum unit.

4.2 At the time of the incident, the "Far Service" was engaged in the same trade since delivery in 1995, which includes the carriage of base oil in No 4 starboard wing/DB cargo tank located outside the aft end of the engine room and abreast of the starboard main engine. Tank cleaning and disposal of remains ashore is sometimes necessary, and is carried out in port, by shore contractors using their own equipment, and the base oil discharge hoses run through the engine room to a road tanker on the quay. This type of tank cleaning operation has been practised for many years without any known incidents.

4.3 For this tank cleaning operation, precautions taken by the ship's staff prior to tank work taking place was a permit to work being raised to isolate any tank operations whilst the tank cleaning was taking place. The contractors carried out tank entry requirements including checking the tank atmospheres and endorsed the same ship's permit and also completed their own tank entry check sheet, pre inspection checklist and time sheet.

4.4 The vessels operator's Safety Management System, Vessel Operation Manual, Chapter 3, Health, Safety and Environment section titled "Safe Job Analysis" also requires a safe job analysis to be carried out if anyone on board has recognised a hazard that may occur during an operation where an established practice or defined procedure had not identified the safety precautions. It would seem that the hazards associated with this tank cleaning operation were not identified and no analysis was carried out.

4.5 At about 0755 hours the contractors commenced removing the remains of base oil (identified as Base Oil (Total DF1) from the ship's tank to the road tanker, utilising a hose made up in sections, running from the base oil tank through the manhole into the starboard side of the engine room at upper level on the outer side of the starboard engine, this being an area of source of heat. The discharge of base oil remains was completed at about 0815 hours.

4.6 The safety data sheet for Base Oil (Total DF1) indicates that it is a hydrocarbon oil. It is used as a drilling fluid chemical, having a minimum flash point of 75 degrees C, flammability limits of 0.6% (lower) to 8%v/v (upper) and autoignition temperature of approximately 220 degrees C, is combustible and should be protected from all forms of heat and ignition sources. Furthermore it can be harmful to a person's skin.

4.7 At about 0758 hours the vessel's main engines were started up, this being a few minutes after the discharge of base oil remains had commenced. Within about 20 minutes the engines were run up at the normal running temperature, which from tests carried out on a sister vessel was ascertained to be between 80 - 90 degrees C on water jacket surfaces, body of indicator cock 160 degrees C, and at the plug for the thermometer at exhaust gas inlet to the turbocharger ranging from 288 to 310 degrees C.

4.8 Therefore base oil being a combustible liquid and having flash points and auto ignition temperatures of 75 degrees C and 220 degrees C respectively, was being discharged through a portable ribbed plastic coated hose running close to the starboard main engine and its exhaust, the engine being in operation and running up to its running temperature of 80 - 90 degrees C and at the plug for the thermometer at the exhaust gas inlet to the turbocharger ranging from 288 to 310 degrees C. The hose section had a connection close to the starboard main engine.

4.9 It was reported that at about 0815 hours, when the discharging of the base oil was almost complete, the charterer's foreman instructed the contractors on the quay to move the vacuum booster unit to position a crane and shortly afterwards one of the contractor's staff shut off the valves on the road tanker prior to moving the vacuum booster unit. It was also reported that at about the same time, the contractors in the engine room indicated to their colleagues on deck that the discharge of base oil remains was completed, and the operation could be suspended.

4.10 It was reported that at about 0820 hours, following advice from the contractors in the engine room that the base oil tank was empty, the charge hand instructed another of the contractor's staff at the road tanker to stop the discharge operation. It was further reported that this person, possibly being unfamiliar with the operation of the vacuum booster unit, operated the valves at the road tanker into what he considered to be the closed position but in fact he had opened the valves. It was also reported that the road tanker inlet/outlet valves were not marked with open/closed positions and also that there can be varying valve positions on different road tankers. It is also likely that at the same time, the contractors in the engine room noted that the vacuum suction had ceased and started to break the hose at the upper engine room plate level, prior to pulling the hose from the tank.

4.11 The requirement to position the crane referred to in 4(9) above interfered with the tank cleaning and removal of base oil operation.

4.12 The consultants who inspected the road tanker and vacuum unit advised that the additional use of the vacuum unit for this operation in tandem with the road tanker unit allowed for the vacuum to be lowered in the tanker unit, permitting greater suction and also acts as an overflow unit in the event of overfilling the road tanker. Furthermore they advised it is likely that the road tanker's suction by itself would be unable lift the liquid from the vessel's tank at this berth at low water, when the vessel is well below the quay level.

4.13 However when the road tanker is used without the vacuum unit, the suction hose is connected to the inlet on the road tanker which feeds into a standpipe thereby creating a non return system, whereas when connecting the vacuum booster unit to the inlet and suction hose from the base oil tank to the discharge of the road tanker, it effectively removes the non return arrangement.

4.14 In view of 4.9, 4.10, 4.12 and 4.13 above, it is likely that at about 0820 hours when the vacuum suction had ceased, and the discharge hose was being disconnected in the engine room following the base oil tank being emptied, the base oil drained back down the hose from the road tanker and spilled out into the engine room close to the base oil tank where the hose section was disconnected. Subsequently the base oil spilled onto the heated areas of the starboard main engine where ignition took place, this being confirmed by the ship's staff.

4.15 The drainage of base oil from the road tanker back to the vessel's engine room was likely due to the road tanker valves being inadvertently opened, with no non return arrangement being fitted in the suction line.

4.16 The ignition of base oil vapour would need the liquid to be heated to 75 degrees C, unless a spray of liquid might have resulted from the contractor attempting to reconnect the hoses when it is possible that the flammable mixture could be ignited at a lower temperature than that for the bulk liquid. At the time of the base oil spillage, the temperature in way of the starboard main engine was likely such that a spray/air mixture could have ignited.

4.17 Sources of ignition in way of the spillage of base oil were investigated and those eliminated were naked flames, electrical sparks from the electric motor for the low temperature cooling pump and fluorescent light fittings. Surfaces of operational machinery would have been close to the base oil's flashpoint but likely below its auto ignition temperature of about 220 degrees C which would prevent ignition occurring. The main engine exhaust gas temperature would have been higher than 220 degrees C, but the manifold was lagged and the external surface of casing unlikely more than about 50 degrees C.

4.18 There are pipes for the turbocharger wash system passing directly into the exhaust stream at the forward end of the outboard side of the starboard main engine, this system being usually used weekly. On the day of the incident, the system was not in use and subsequent recordings of temperatures of the same pipes on a sister vessel, were in excess of 288 degrees C. Furthermore simulated tests carried out on the turbo charger connections on "Far Service" following repairs resulted in maximum temperatures of 232.9 degrees C being recorded. Therefore as the pipes were in the line of spillage, it seems likely that a spray of liquid could have made contact, and their surface temperature being in excess of the auto ignition temperature of the base oil, this was the probable source of ignition.

4.19 Had there been clear and concise procedures and communications in place for the operation of the road tanker and vacuum unit and also for disconnecting the discharge hoses and an effective non return arrangement in use, the back flooding of base oil and the resultant spillage onto heated machinery surfaces would likely not have occurred.

4.20 There appears to have been no effective liaison between the charterer's foreman on the quay and the tank cleaning contractors regarding moving the vacuum booster unit, when an instruction was given by the charterers to the tank cleaners to move the vacuum booster unit at a time within a few minutes of completion of the removal of base oil operation. Had the discharge of base oil remains been completed prior to moving the vacuum booster unit, it is possible that the back flooding of base oil may not have occurred.

4.21 Had the main engine not been run up to the working temperatures or at such temperatures after shutting down the engines, any spilled base oil would unlikely have ignited.

4.22 The missing person pronounced dead by the fire brigade in the fire area, was later confirmed to have died as a result of an industrial fire. It is likely but unconfirmed that this person had been tending the hose which had been uncoupled in order to remove it from the tank. Subsequently base oil drained back down the hose from the road tanker and spilled onto the heated areas of the engine and caused a flash fire. His body was located at the bottom of the stairwell leading to the aft open deck and he was likely attempting to escape from the fire.

4.23 A confidential draft of this report was forwarded to the vessel's operations manager and four senior officers and as a result of comments received, minor changes were made to all sections of the report.

5. Conclusions

5.1 At the time of the incident, the platform supply vessel "Far Service" was a well found vessel, involved in a typical tank cleaning operation removing base oil remains, as regularly carried out in the offshore industry. However it is possible that the tank cleaning contractors staff were not provided with information regarding the hazards of base oil.

5.2 Large quantities of base oil, being a combustible liquid which should be protected from all forms of heat and ignition sources, had been removed from No 4 Side/DB tank to a road tanker using hoses passing through the engine room. Much of this base oil was inadvertently allowed to back flood and spill into the engine room, due to the incorrect use of the road tanker and non usage of its non return system and also lack of safe procedures when disconnecting the suction hoses.

5.3 The spilled base oil likely made contact with the heated surfaces of pipes for the turbo wash system located forward and outboard of the starboard main engine. This engine had been in operation for about 30 minutes before the incident and was at full working temperatures which could ignite base oil, and it likely resulted in ignition and a flash fire occurring.

5.4 The vessel's operators, charterers and tank cleaning contractors should have been aware of the dangers of base oil, being a combustible liquid which can ignite if it makes contact with an ignition source, such as heated surfaces of machinery.

5.5 The vessel should not have run up the main engines to working temperatures whilst the removal of base oil remains was taking place.

5.6 The deceased person, who was tending the base oil hoses in the area of the spillage, died as a result of an industrial fire.

5.7 Immediately following the outbreak of the fire, the vessel's staff attempted without delay and in a professional manner to contain and extinguish the fire and also to rescue the missing person. They were subsequently of great assistance to the fire brigade in securing the engine room resulting in the fire being contained and extinguished.

6. Recommendations

6.1 Future designs of platform supply vessels, to be utilised for the carriage of base oil and any other combustible liquid cargoes, should incorporate associated tank cleaning arrangements which does not necessitate the use of portable hoses passing through engine rooms and any other areas of the vessel where sources of ignition exist.

6.2 Platform supply vessels of a similar design to "Far Service" whereby the tank cleaning arrangements for base oil and other combustible liquid cargo tanks necessitate the use of portable hoses passing through an engine room or other areas of the vessel where sources of ignition exist, should only carry out the tank cleaning operations when the main engines and other machinery in way of the hoses are shut down, and are well below working temperatures and/or protected such that in the event of an inadvertent spillage from the hose/s onto heated surfaces, the risk of ignition occurring is minimised.

6.3 The operator's of the vessel should consider formal familiarisation training for the tank cleaning contractors, in particular to include working areas, alarms, location of emergency equipment and escape routes from their work areas in the engine room, which could be incorporated into permits to work.

It is understood that this familiarisation training has now been implemented.

6.4 The operator's of the vessel should review their safety management system regarding key shipboard operations and continue to utilise permits to work and risk assessment to incorporate the risks as detailed in 6.2 and 6.3 above. Reference is made to Farstad Shipping, Vessel Operation Manual Chapter 3, requiring a Safe Job Analysis to be carried out for hazardous operations. In addition data sheets for base oil and similar combustible liquid cargoes should be posted up and the hazards of the cargo brought to the attention of the shore contractors and referred to in the permit to work.

It is understood that an improved permit to work system and a risk assessment form in conjunction with the existing safe job analysis has been implemented and related training given to all appropriate personnel.

6.5 The tank cleaning contractors should review their procedures for base oil tank cleaning, including documented procedures such as issuing their own permits to work and risk assessments to be completed, particularly with this type of vessel arrangement to ensure that:-

(a) A designated person is in overall charge of the operation so that:-

(i) Safe and controlled tank entries are made
(ii) Safety equipment is available outside the tank
(iii) Their staff wear appropriate personal protective equipment where necessary
(iv) Safe operation of the road tanker and vacuum unit is maintained
(v) Effective communications are maintained between their staff both in the engine room and tank areas and vehicles on the quay to avoid inadvertent spillage of base oil or similar combustible liquids

(b) Their staff involved are made fully aware of the dangers and hazards of base oil and similar hazardous products

6.6 The tank cleaning contractors should consider fitting non return arrangements to their road tankers which should always be used when discharging base oil remains and similar combustible liquids, to avoid back flooding from the road tanker through the base oil suction hose and back to the ship's tank.

6.7 Controls and records of the numbers of contractor's personnel involved in the tank cleaning on board the vessel should be maintained at all times.

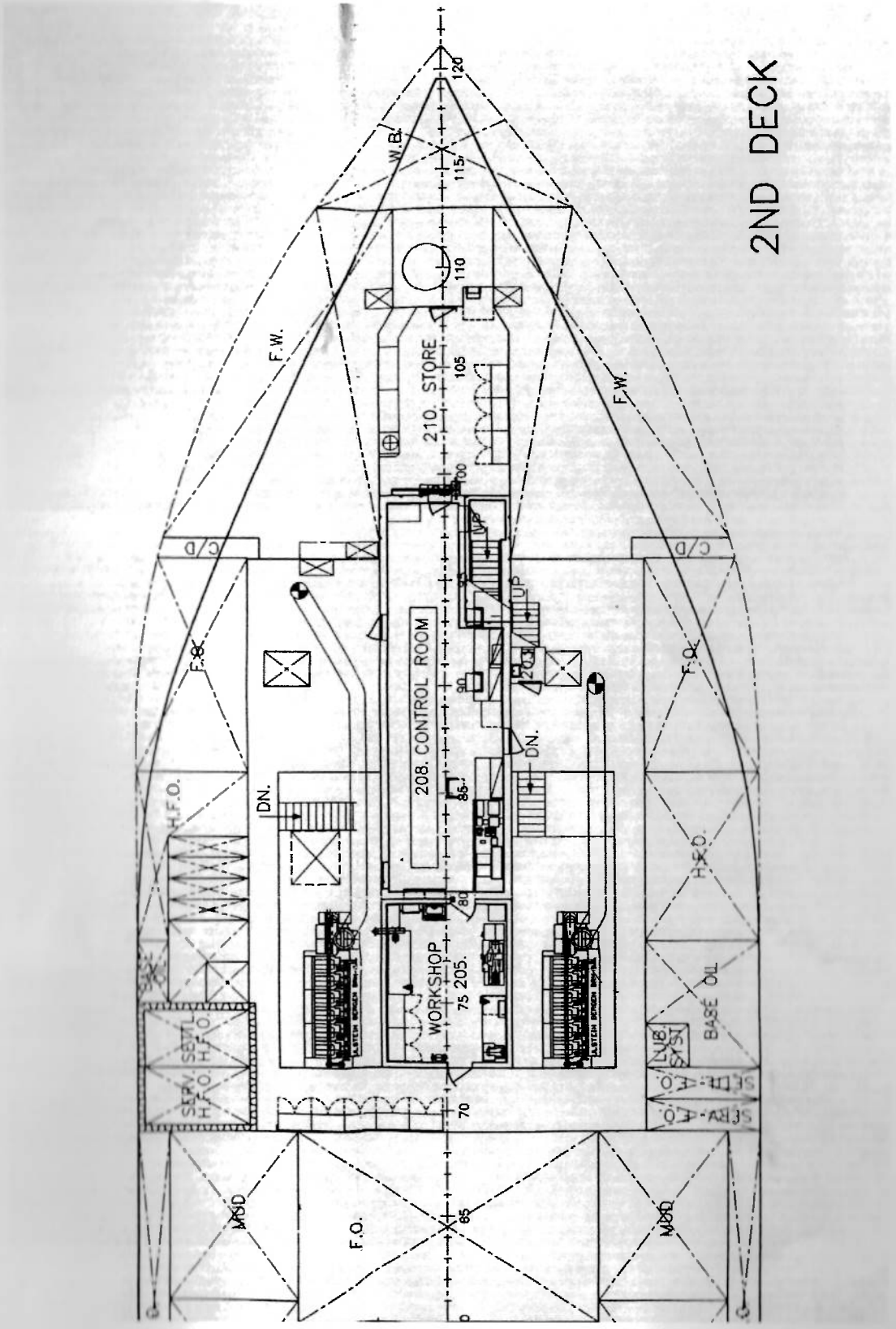
It is understood that such controls and associated recording has now been implemented.

6.8 Taking into consideration the above recommendations, the vessel's operators and tank cleaning contractors should jointly review their procedures for base oil tank cleaning operations to clarify lines of communication and exact areas of responsibility, to result in the highest level of safety standards being maintained.

It is understood that the above recommendation has been implemented

7. Appendices relating to the report

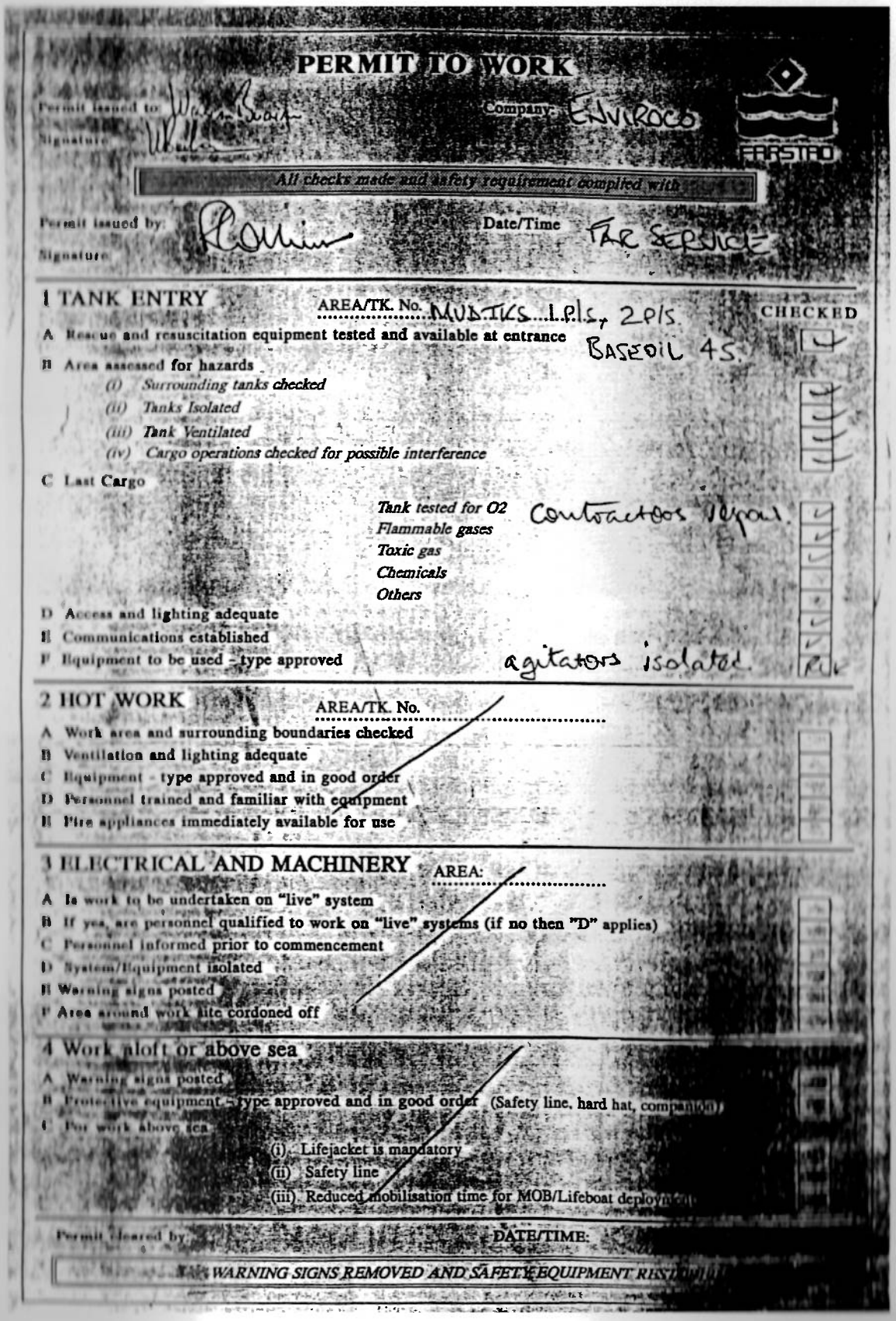
Appendix 1


2ND DECK
W.B.
F.W.
F.W.
F.W.
210. STORE
208. CONTROL ROOM
205. WORKSHOP
DN.
DN.
UP
C/D
C/D
F.O.
F.O.
H.F.O.
H.F.O.
SERV. H.F.O.
SETTL. H.F.O.
BASE OIL
LUB. OIL SYST.
SERV. L.O.
SETT. L.O.
MUD
MUD
F.O.
120
115
110
105
100
90
85
80
75
70
65

Appendix 2

Turbo Vac Unit

Appendix 3



PERMIT TO WORK

Permit issued to: [illegible] Company: ENVIROCO

Signature: [illegible]

FRASTO

All checks made and safety requirement complied with

Permit issued by: [illegible] Date/Time FAR SERVICE

Signature: [illegible]

1 TANK ENTRY

AREA/TK. No. MUDTKS 1.p.l.s, 2p/s. BASEOIL 4S.

CHECKED

A Rescue and resuscitation equipment tested and available at entrance ✓

B Area assessed for hazards ✓

(i) Surrounding tanks checked ✓

(ii) Tanks Isolated ✓

(iii) Tank Ventilated ✓

(iv) Cargo operations checked for possible interference ✓

C Last Cargo

Tank tested for O2 Contractors Repair. ✓

Flammable gases ✓

Toxic gas ✓

Chemicals ✓

Others ✓

D Access and lighting adequate ✓

E Communications established ✓

F Equipment to be used - type approved agitators isolated. ✓

2 HOT WORK

AREA/TK. No. .....

A Work area and surrounding boundaries checked

B Ventilation and lighting adequate

C Equipment - type approved and in good order

D Personnel trained and familiar with equipment

E Fire appliances immediately available for use

3 ELECTRICAL AND MACHINERY

AREA: .....

A Is work to be undertaken on "live" system

B If yes, are personnel qualified to work on "live" systems (if no then "D" applies)

C Personnel informed prior to commencement

D System/Equipment isolated

E Warning signs posted

F Area around work site cordoned off

4 Work aloft or above sea

A Warning signs posted

B Protective equipment - type approved and in good order (Safety line, hard hat, companion)

C For work above sea

(i) Lifejacket is mandatory

(ii) Safety line

(iii) Reduced mobilisation time for MOB/Lifeboat deployment

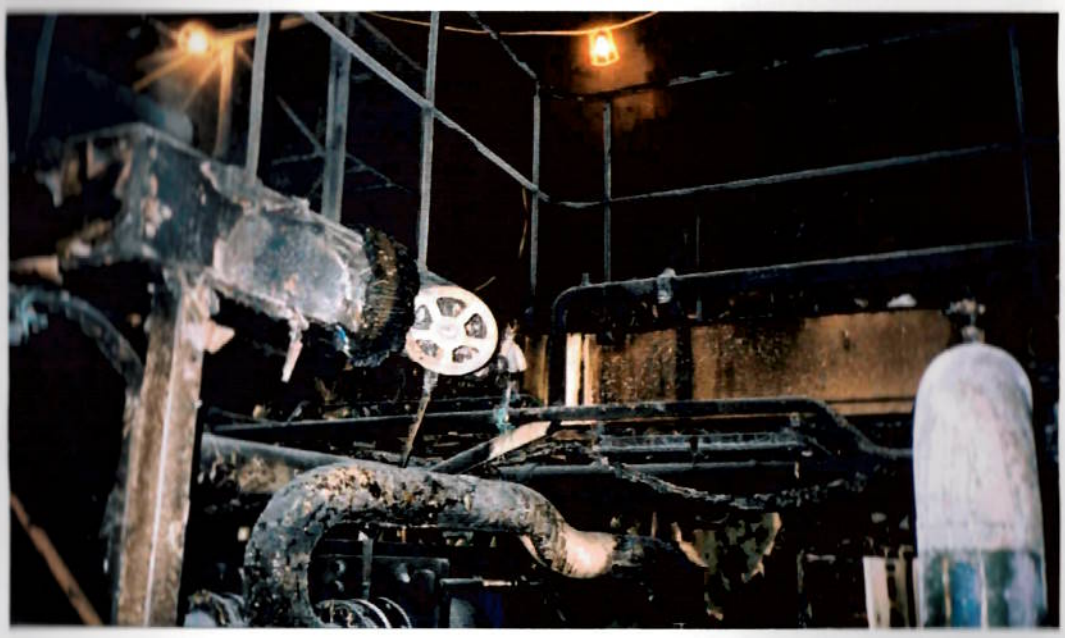
Permit cleared by: DATE/TIME:

WARNING SIGNS REMOVED AND SAFETY EQUIPMENT RIST[illegible]

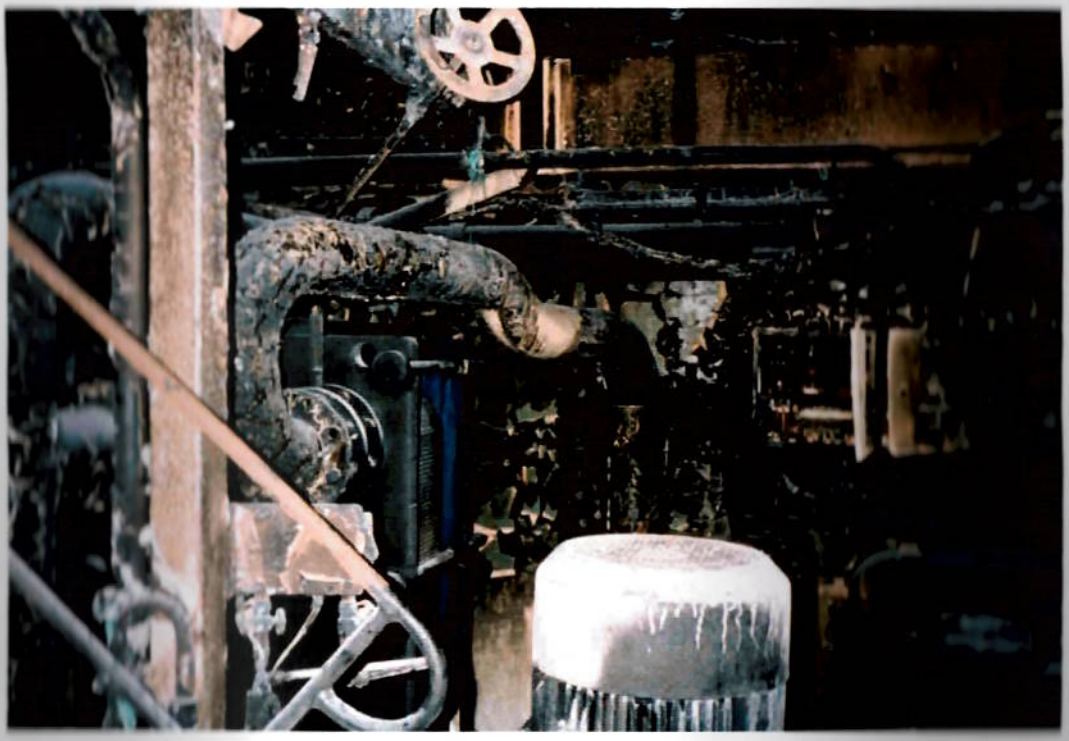
Appendix 4

Fire damage at walkway by base oil tank manhole at outer starboard side of starboard main engine

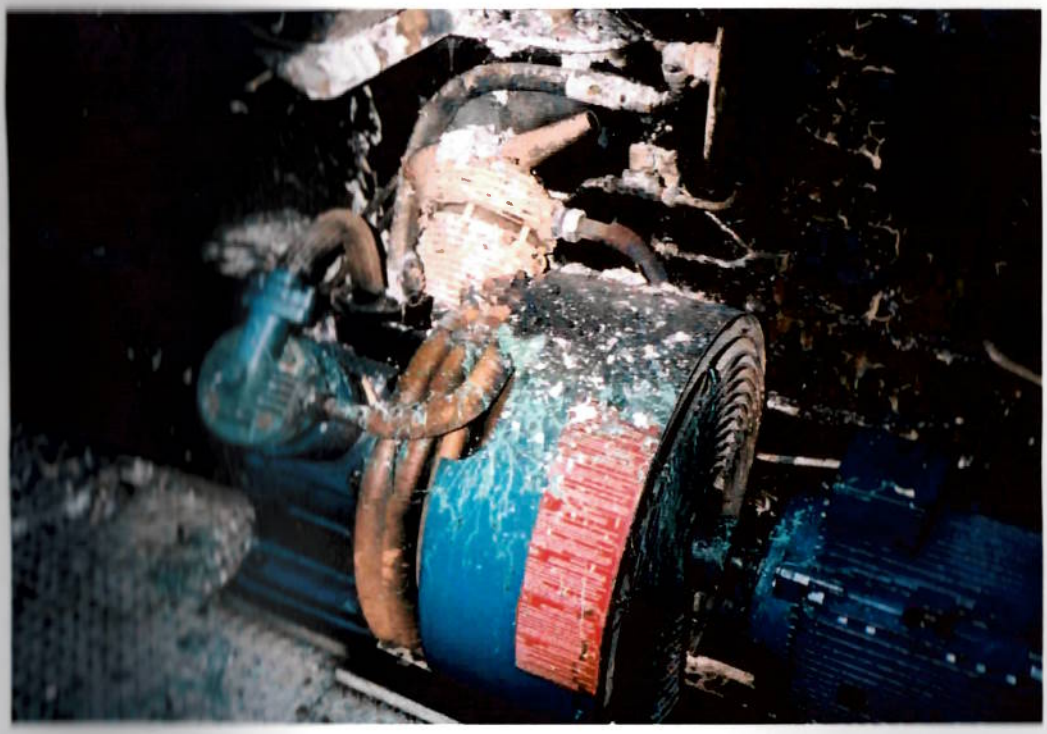
Appendix 4



General fire damage

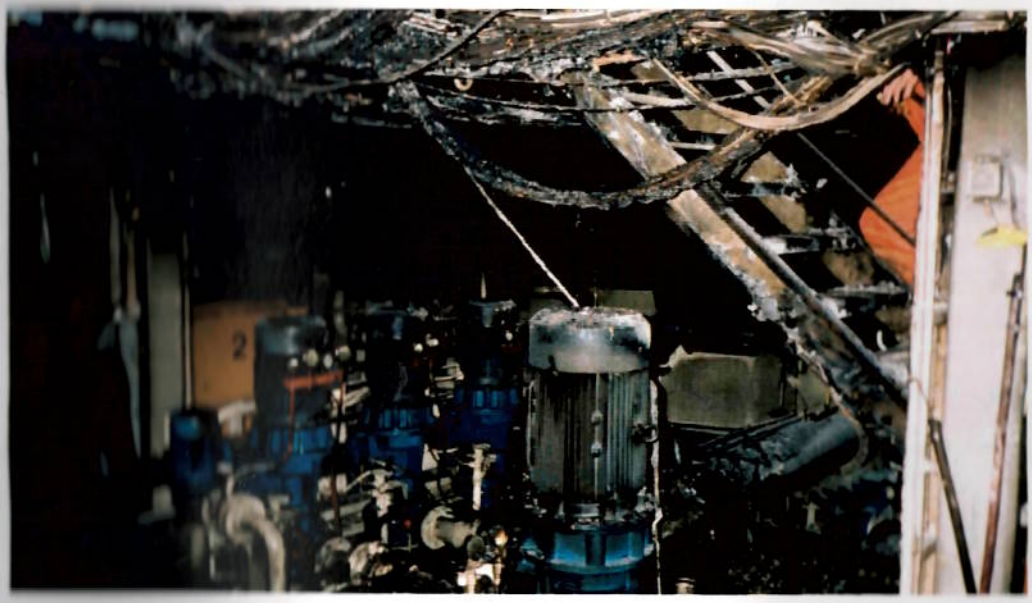


Appendix 4



General fire damage

Appendix 4



Fire damage to electrical fittings and wiring

Appendix 4

Fire damage at stairwell access from engine room to deck

Appendix 4

Contractor's portable light

Base oil hose connection

Appendix 4

Base oil hose remains with connections at bottom of deck stairwell

Appendix 5

SAFETY DATA SHEET

to EEC Directive

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND THE COMPANY

Product **Base Oil (Total DF1)**

CAS Number	64742-47-8	Unit size	Bulk barrel
Formula	Hydrocarbon oil	Supplier	BW Group plc, Minto Drive,
Emergency Contact	A Popplestone (01224 879013)		Altens, Aberdeen, AB12 3LW

BW Group plc

2. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient Name	Concentration % wt	Hazard	CAS Number
Low Aromatic Hydrocarbon Oil	100	Harmful	64742-47-8

3. HAZARDS IDENTIFICATION

Harmful : May cause lung damage if swallowed.

4. FIRST AID MEASURES

Eye contact	Irrigate thoroughly with water for at least 10 minutes. If discomfort persists obtain medical attention.
Skin contact	Remove contaminated clothing. Wash off skin thoroughly with soap and water.
Ingestion	Wash out mouth with water. Do not induce vomiting. Seek medical attention.
Inhalation	Remove from exposure, rest and keep warm. Obtain medical attention.

5. FIRE-FIGHTING MEASURES

Extinguishing agents	Foam, dry powder or CO_2.
Unsuitable extinguishing agents	Water.
Special exposure hazards	Evaporation of product may cause subsequent fire hazard. Product is combustible. Take precautionary measures against static discharge during blending and transfer operations.
Special protective equipment	Use full self contained breathing set. Protective clothing, including impervious gloves, should be worn if skin contact is anticipated. Wear face visor or goggles if eye contact can accidentally occur. Product spilt on clothing may give rise to delayed evaporation and subsequent fire hazard.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions	Avoid contact with skin. Wear protective clothing and impermeable gloves. If there is a splash risk also wear goggles or safety glasses.
Environmental precautions	This product is not to be disposed to the sea. Onshore use all practical means to prevent water or soil contamination.
Methods for cleaning up	Remove all sources of ignition. Contain or absorb with sand or other non-combustible material. Report any escape to public drains or streams to the water authority immediately. Dispose of waste at an approved site.

7. HANDLING AND STORAGE

Handling precautions	Avoid contact with skin. Material is delivered bulk and should remain in the mud or base oil tanks prior to use.
Storage conditions	In bunded bulk tanks.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Recommended use	Drilling fluid chemical
Personal protective equipment	
Respiratory protection	Not required under normal conditions of use. Do not enter confined spaces without breathing apparatus.
Hand protection	Rubber or plastic gloves.
Eye protection	Safety glasses or goggles.
Skin and body protection	Coveralls or laboratory coat.
Exposure limits	Monitoring of the workplace should be considered in accordance to EN689 or equivalent controls.
	OES (Oil Mist, Mineral) - LTEL (8hr TWA) = 5 mg/m³
	- STEL (15 mins TWA) = 10 mg/m³

The information contained in this safety data sheet is given in good faith. It is accurate to the best of our knowledge and belief and represents the most up to date information available. However, the information given in this data sheet does not constitute or replace the user's own assessment of workplace risk as required by other health and safety legislation.

Appendix 5

9. PHYSICAL AND CHEMICAL PROPERTIES

Colour	Colourless	Form	Liquid
Odour	Slight oil odour	pH	Neutral
Boiling point/range	200-250°C	Melting point/range	Not reported
Flash point	75°C minimum	Flammability Limits	Upper 8%v/v, lower 0.6%
Autoignition temperature	Approximately 220°C	Water solubility	Not water soluble
Other data	sg 0.80 g/ml	Viscosity	1.5 cSt (40°C)

10. STABILITY AND REACTIVITY

Stability	Product is combustible.
Conditions to avoid	Protect from all forms of heat and ignition sources.
Materials to avoid	Oxidising agents, strong acids/alkalis and halogens.
Hazardous decomposition products	Combustion will produce toxic gases.

11. TOXICOLOGICAL INFORMATION

Toxic effects	Product is non toxic under normal offshore and onshore usage conditions.
Eyes	Contact with eyes can result in intense smarting and irritation.
Skin	Classified as non irritant to OECD GL 404. Prolonged and repeated contact [illegible] defat the skin leading to irritation and possible dermatitis.
Ingestion	Harmful. May cause lung damage if swallowed.
Inhalation	Inhalation may cause gastric irritation. The main risk involves the aspiration into the lungs which could cause pneumonitis. Vapour at high concentrations may cause [illegible] headache, nausea and/or irritation.

12. ECOLOGICAL INFORMATION

In water the product is insoluble and will spread over the surface. In soil the product is only slightly mobile and will partially evaporate. Product is classified as an oil mud by the DTI and product disposal offshore is not permitted.
Readily biodegradable. Ratio BOD/COD was 239% after 28 days. Has the potential to bioaccumulate.
Aquatic Toxicity - 96 hr LC_{50} (fish) >1000 mg/l - classified as non toxic.

13. DISPOSAL CONSIDERATIONS

Re-use within mud system. Otherwise absorb product on inert material and ship to shore for disposal or incineration at approved site. Spills onshore should be prevented from entering the drainage system by recovery of liquid and disposal at an approved site. It is an offence to discharge to public drains, marine or inland waters.

14. TRANSPORT INFORMATION

PROPER SHIPPING NAME : Not Restricted

UN number	Not registered	IMDG hazard class	None
Packaging group	Not applicable	Marine pollutant	No
EMS number	Not applicable	EINECS number	265-149-8
MFAG number	Not applicable		

15. REGULATORY INFORMATION

Supply classification

Hazard symbol(s)	Xn Harmful
Risk phrases	R65 - Harmful : may cause lung damage if swallowed.
Safety phrases	S23 - Do not breath vapour.
	S24 - Avoid contact with skin.
	S62 - If swallowed do not induce vomiting; seek medical advice immediately and show container or label.
OCNS status	Category Z. Use approved as part of an oil mud system. Disposal offshore is not allowed.

16. OTHER INFORMATION

Recommended use	Base Oil is the continuous phase of the BW Inverkleen oil mud system. The concentration required within the mud varies depending on required mud weight and rheology as outlined within the mud programme.
Further information	-

The information contained in this safety data sheet is given in good faith. It is accurate to the best of our knowledge and belief and represents [illegible] given in this data sheet does not constitute or replace the user's own assessment of workplace risk as required by other health and safety legislation.

Doc. Base Oil (Total DF1), Ref.: Section 3 - 030 Page 2 of 2 [illegible]